



Munich Personal RePEc Archive

## **Sustainable trends in producer price indices**

Kitov, Ivan and Kitov, Oleg

IDG RAS

12 May 2009

Online at <https://mpra.ub.uni-muenchen.de/15194/>

MPRA Paper No. 15194, posted 14 May 2009 00:09 UTC

# **Sustainable trends in producer price indices**

Ivan O. Kitov, Oleg I. Kitov

## *Abstract*

Previously, linear trends were revealed in the differences between the headline CPI and the price indices for various subcategories of the CPI in the United States. These trends can be continuous, as observed with the price index for medical care, or piecewise with turning points between trends with opposite signs. Similar features are found for the PPI and its components. The presence of sustainable trends in the differences allows prediction of prices for various commodities at time horizons of several years. In addition, it is possible to time the start of transition to the next trend. Accordingly, the trends reduce the uncertainty in forecasting prices for major commodities and also for their small components. The usage of trends in the PPI could bring substantial benefits to producers (planning) and stock market participants (timely investment).

Key words: PPI, CPI, US, prediction

JEL classification: E31, E37

## Introduction

In the United States, prices for various subcategories of consumer expenditures evolve in a practically predetermined way [1-3]. As a rule, the difference between the price index for a given subcategory and the headline CPI is characterized by the presence of sustainable linear trends, i.e. this difference can be accurately approximated by a linear function of time. In several aggregate subcategories such as medical care and education/communication observed trends are rock solid over time. Other subcategories including energy, food, housing, and transportation demonstrate a piecewise structure with linear trends swapping between positive and negative ones [1]. For tiny subcategories like apples and women's footwear [2] or mid-size ones like motor fuel [3] linear trends are also present, but for many small subcategories the dependence on time is more complicated than linear one.

There are products which are not covered by the headline CPI. For example, such commodities as fuels, metals, chemicals, etc. are associated with the producer price index, PPI. (We use not seasonally adjusted producer price indices retrieved from the BLS web-site - <http://www.bls.gov/data>.) It is likely that the difference between the PPI and its subcategories is also characterized by the presence of linear trends, which would support the assumption that the evolution of producer price indices relative to the PPI is not a stochastic process. Sustainable trends in the differences allow predicting prices at various time horizons.

The remainder of this paper is organized as follows. Section 1 presents linear trends in the difference between the headline CPI the index for housing, and formally introduces the model developed in [1-3] in the form of quantitative relationship. In Section 2, the model is applied to all major (two-digit) categories of the PPI. As a result several sustainable trends, both linear and nonlinear, are revealed. Section 3 compares the trends observed in related subcategories of the CPI and PPI – fuels and food. In Section 4, eight subcategories (three-digit and lower) of the price index for metals and fuels are analyzed. Robust trends are also revealed.

### 1. Linear trends in CPI

Before we start analyzing linear trends in the PPI let's demonstrate the presence of similar features in consumer price indices, as derived and validated in [1-3]. It was found that the difference between the (headline) CPI,  $hCPI$ , and some individual index,  $iCPI$ , can be approximated by a simplest time function:

$$hCPI(t) - iCPI(t) = A + Bt \quad (1)$$

where  $A$  and  $B$  are empirical constants, and  $t$  is the elapsed time. Therefore, the “distance” between the headline CPI and given individual index is a linear function of time, with a positive or negative slope  $B$ .

The difference between the headline CPI and the price index for housing (both seasonally adjusted) provides an appropriate demonstration of the presence of linear trends. Left panel of Figure 1 displays this difference between 1960 and 2009. There are three distinct periods of linear dependence on time: from 1970 to 1987, from 1987 to 1996, and from 1996 to 2006. There are also two turning points in 1987 and 1996, where the trends undergo changes. Since 2007, the difference has been passing third turning point with very high volatility, especially in the end of 2008 and in the beginning of 2009. In the past, the trends were very strong attractors to all deviations. Therefore, it is likely that in the near future a new linear trend will emerge, which will repeat the previously observed duration and slope.

Right panel in Figure 1 presents quantitative parameters of the most recent linear trend. Between 1996 and 2007, the difference was falling at a rate of 0.59 units per year. A fundamental feature of the difference consists in the fact that all deviations from the trends were only short-term ones. This implies that the current or near-future deviations from the new trend should be rapidly compensated.

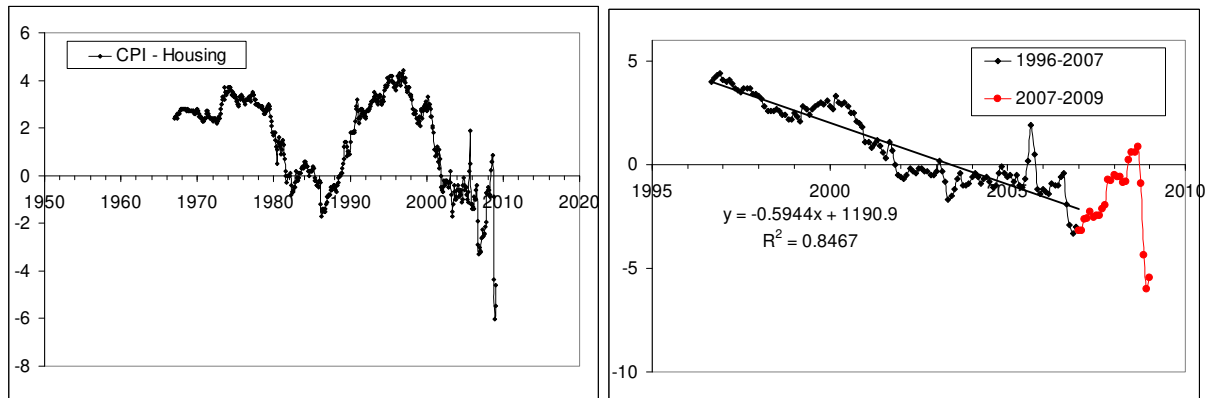


Figure 1. Illustration of linear trends in the difference between the headline CPI and the index for housing in the U.S. Left panel demonstrates the full history of the difference between January 1967 and March 2009. There are three quasi-linear segments with two turning points near 1987 and 1996. Currently, the difference passes third turning point. Right panel displays the most recent linear trend with relevant regression line.

## 2. Linear trends in major categories

In Section 1, we have established that the evolution of the price index for housing relative to the headline CPI is hardly a random process but rather can be accurately described by a linear function of time. In developed economies, producer price indices are inherently related to CPI. Therefore, one may formulate the following question - are there linear trends in PPI?

Figure 2 displays the evolution of selected (two-digit) categories of the overall PPI in the USA between 1960 and 2009. Before 2001, all curves, except that for the index for fuels, were not diverging from the PPI by more than 10 units. After 2001, the curves have been rapidly deviating with the final difference of ~140 units between the index for fuels and that for machinery in 2008. In the second half of 2008, a rapid fall started in the indices for fuels (dramatic), metals, chemicals, and processed food. No significant changes were observed in the indices for furniture and household durables, transportation equipment, and machinery and equipment. The index for nonmetallic mineral products has been demonstrating a visible increase relative to its long-term trend. The overall PPI has been also decreasing since July 2008 in sync with its major components.

All in all, general features of the evolution of the components relative to the PPI are not clear from Figure 2. A better representation is given in Figure 3, there the differences between the PPI and all its (first level or two-digit according to the BLS classification) components are displayed.

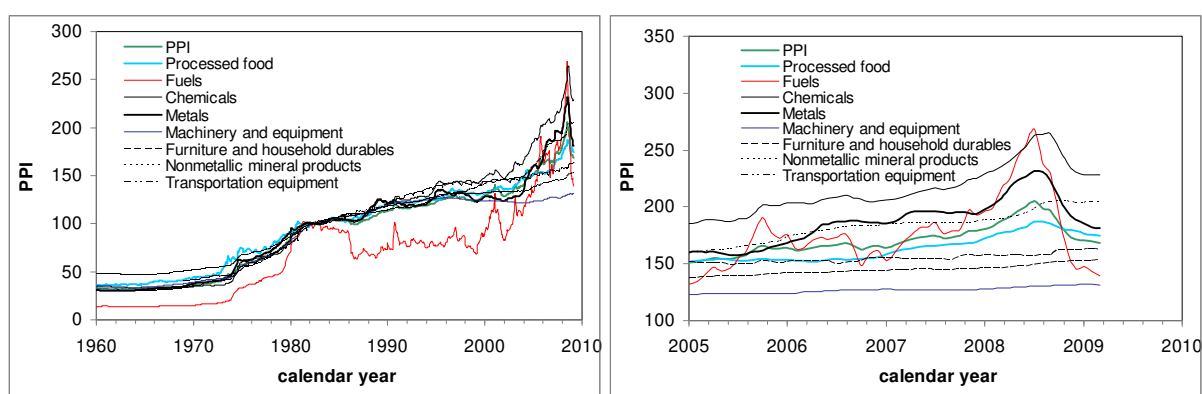


Figure 2. *Left panel:* Evolution of the price indices for selected commodities between 1960 and 2009. Between 1960 and 1975, the indices were not changing. *Right panel:* Same for the period between 2000 and 2010.

The difference between the PPI and the index for farm products demonstrates a strong (positive) trend since 1974. This trend is practically linear with deviations from the trend increasing over time. The positive slope implies that the weighted average price for all commodities together (PPI) has been growing at a higher rate than the index for farm products. There is no sign that the positive trend is going to swap to a negative one, and thus the farm products will continue losing their price setting power.

Between 1980 and 2004, the index for processed food and feeds was showing a linear trend which is parallel to the zero line. After 2004, a major deviation has been observed, which returned, however, to the long-term trend in 2009. In the future, this index will likely retain the same zero-slope trend and the price setting power of processed food relative to the PPI will not change.

The index for textile and apparel has been growing at a decelerating rate relative to the PPI since the very beginning. The difference depicted in Figure 3 reveals a rather exponential than linear growth since 1960. We would prefer to split the curve into two linear segments – before and after 2000. Then the

positive trend observed after 2000 is currently turning to a negative one. In 2009, a significant correction of the index relative to the PPI happened – the difference fell from ~80 to ~40. The index for textile has not been changing, however, and the correction is related to the drop in the PPI itself. One can suggest that the difference will follow up the changes in the PPI.

The index for transportation equipment is very similar to that for the textile with a massive drop (~40 units) in the difference in 2009. The trend between 1980 and 2000 was slightly negative. The index for fuels and related products and power contains three linear segments and two distinct turning points. Currently, the difference passes third turning point and the price for fuels will be growing at a lower rate than the PPI.

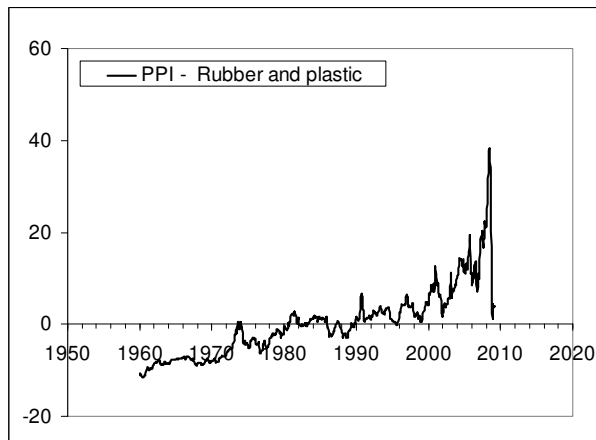
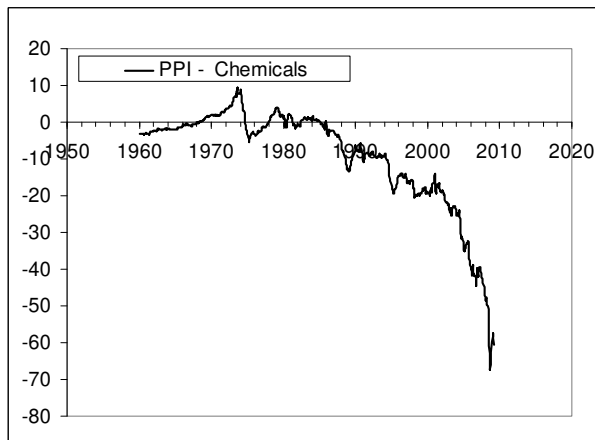
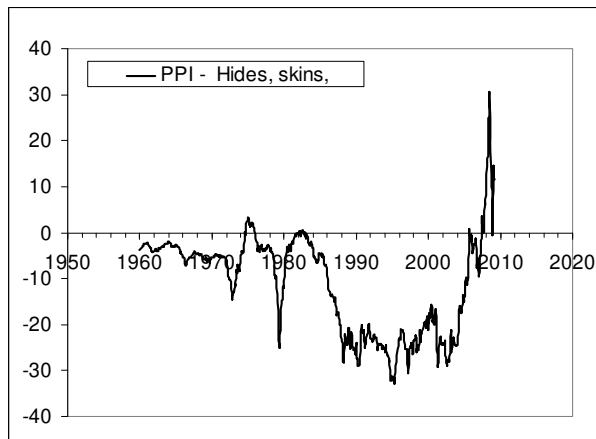
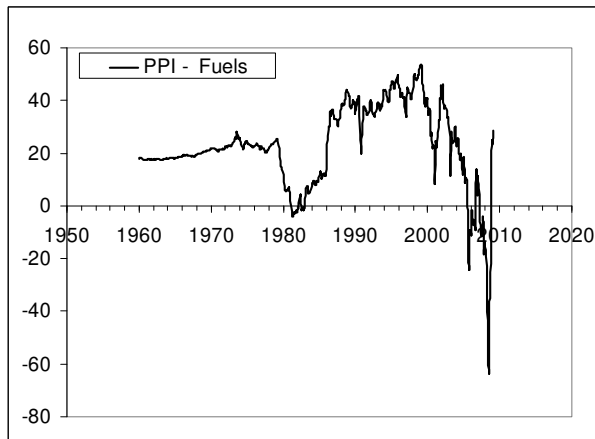
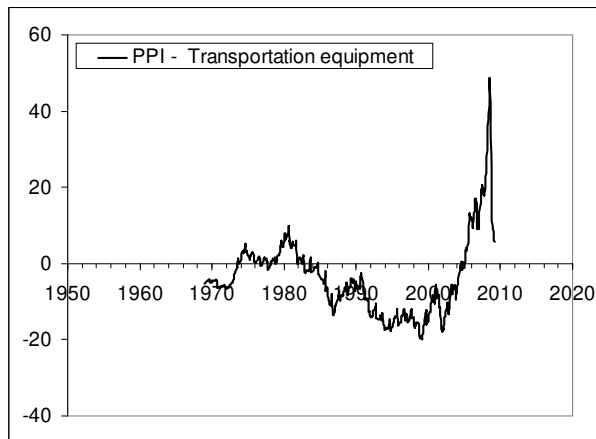
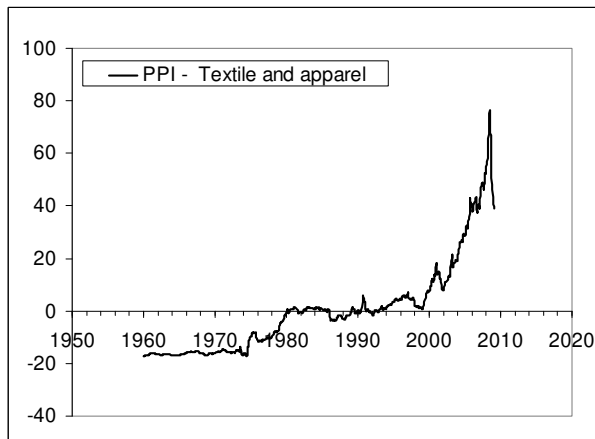
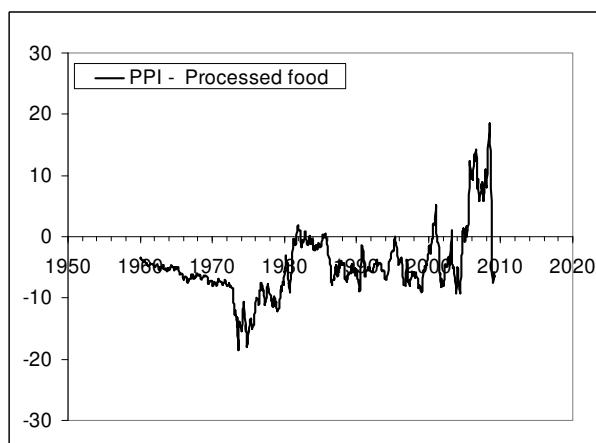
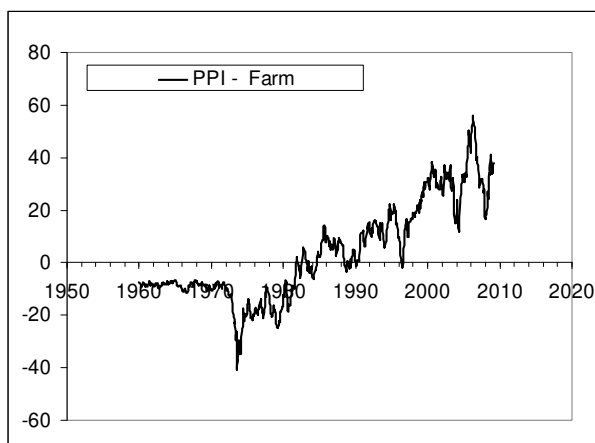
The index for hides, skins, leather, and the related products mimics the behavior of the index of transportation equipment. The index for rubber and plastic products repeats the index for farm products in shape but not in amplitude. The drop in 2009, which was not observed in the index for farm products, was dramatic and the difference practically reached the zero line. The index for chemicals and allied products demonstrates a high price setting power and has been (practically exponentially) increasing the deviation from the PPI since 1980. There was no significant correction of the difference in 2008 and 2009, i.e. the index for chemicals has been falling in sync with the PPI since the mid-2008. In the near future this index might reach its bottom and change its current trend to a positive one. Otherwise, we will observe a run-away.

The index for lumber and wood products does not show reliable linear trends. However, it has been growing rapidly since 2000 and has reached the zero line. The difference should turn to a negative trend in the years to come. The index for pulp, paper, and allied products had a reliable negative linear trend between 1980 and 2000. Then it turned to a positive linear trend. Despite the spike in 2009, we would expect the difference to follow up the positive trend during the next several years.

The index for metals and metal products had a remarkable rally between 2000 and 2008: the difference with the PPI fell from +10 to -30. The rally is over with a major correction of 15 units. The year of 2009 is likely to be the turning point to some positive trend, which will bring the difference to the zero line sometime around 2015.

The index for machinery and equipment and that for furniture and household durables both follow up the track of the index for textile and apparel. The index for nonmetallic mineral products has a fascinating history of fluctuations around a generally negative trend since 1980. The last fluctuation was a spike-like one with the difference jumping by +25 and then by -35 units just during several months.

Having studied fourteen two-digit commodities we found several robust examples of the presence of linear trends in their differences with the overall PPI. Sometimes the observed trends are not purely linear ones, but still are very sustainable over time. There are several turning points between trends with opposite signs with timing dependent on commodity. For some commodities, such transitions happen right now and we should wait before new trends will be developed. In any case, trends in the differences (linear or nonlinear) allow foreseeing the near future, which has a positive impact on both industries and stock market.



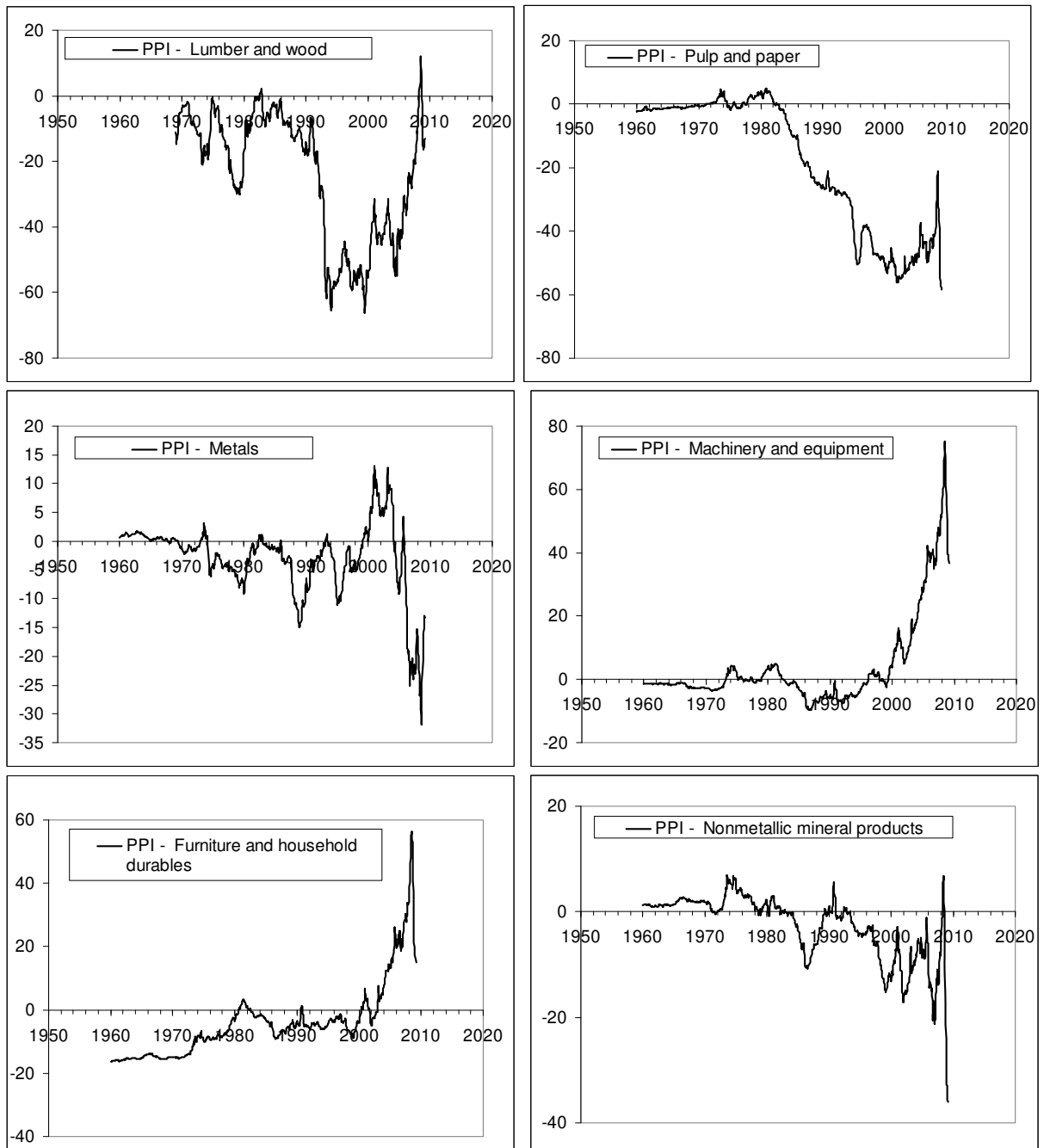


Figure 3. Evolution of the differences between the PPI and price indices for individual first-level commodities: farm products, processed food, textile and apparel, fuels, hides and skins, chemicals, rubber and plastic, lumber and wood, pulp and paper, metals, machinery and equipment, furniture and household durables, nonmetallic mineral products, as published by the US Bureau of Labor Statistics (<http://data.bls.gov/cgi-bin/>). Notice various types of long-term behavior and amplitudes of fluctuations

### 3. PPI vs. CPI

By definition, consumer and producer price indices consist of different components. However, there exist tight links between selected subcategories of CPI and PPI. So, it would be instructive to compare related components. Figure 4 presents two most obvious cases: energy and food. The difference between the headline CPI and the index for energy mimics the difference “PPI-Fuels” almost one-to-one. Therefore, general results, obtained in [1] for the food index, are valid for the index for processed food, i.e. the presence of robust linear trends, two turning point in the past,



and the current transition to a new (linear) trend. Biggest peaks and troughs are well synchronized, but their amplitudes are different. This may be a result of the difference in the components of “energy” and “fuels” as well as the difference in the content of the CPI and PPI. In any case, one can consider that the producer price for fuels almost completely passes through into consumer price for energy. Sad news for the producers of “fuels” is that the trend under development has a positive slope and relevant price index will be growing at a lower rate than the PPI. It is likely that during the next 10 years corresponding price will be falling. In the nearest future (second half of 2009) the price will grow by 50 percent due to a strong overshoot in the current price [3].

The behavior of the consumer price index for food is also similar to that of the producer price index for processed food. There are significant deviations in amplitude even when the curves in Figure 4 are parallel. Moreover, the difference for the index for food is only a half of the difference for the index for processed food, as expressed by a factor of 2 needed to match the full range of change between -20 and +20. The 5-unit offset is of no significance. Hence, only fifty percent of the price change in the index for processed food passes through into the price of food.

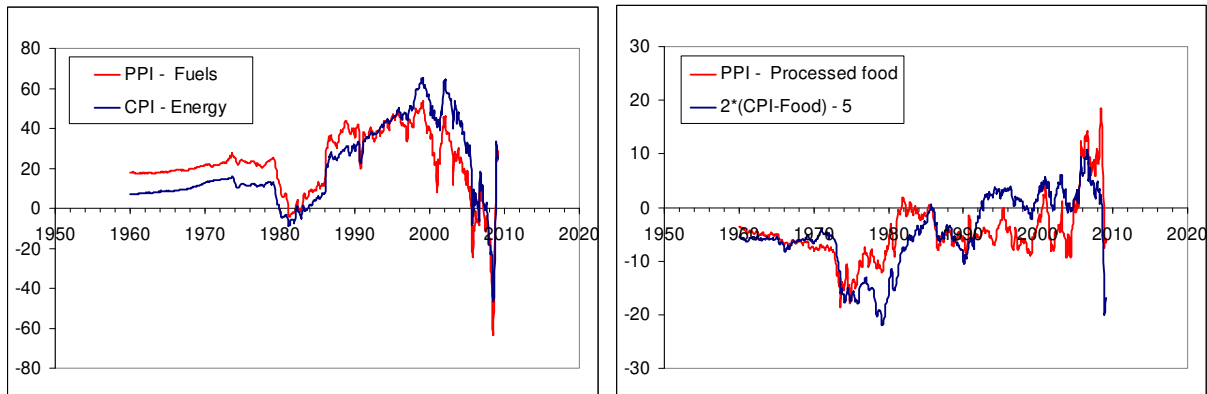


Figure 4. *Left panel:* Difference between the headline CPI and the index for energy versus the difference between the PPI and the index for fuels and related products and power. These differences evolve almost in sync. *Right panel:* same for the CPI – the index for food and the PPI – the index for processed food.

#### 4. Trends in small subcategories

So, the two-digit commodities are characterized by the presence of sustainable (often linear) trends with well-predicted behavior. Do smaller components of the PPI, for example three-digit ones, demonstrate the same features? To answer this question we have selected several components of two commodities with a very large change in price index in 2008 and 2009 – metals (10) and fuels (05).

Figure 5 summarizes our findings. This time the differences between the PPI and indices for individual commodities are normalized to the PPI. As a result, Figure 5 displays relative deviation of a given index from the PPI. The reason for this representation consists in the

nonlinear dependence of relative change (or inflation) on the level of price index. For example, the change of index from 10 to 11 gives 10% inflation and the change from 100 to 101 gives only 1% inflation. The difference normalized to the PPI provides a level independent estimate of deviation. In practice, the normalization converts linear trends in the absolute difference into a constant level line in the normalized difference, if the PPI can be approximated by a linear function of time. When the absolute difference can be approximated by time squared, the normalized difference is a linear function of time.

The normalized difference between the PPI and the index for iron and steel (101) is characterized by the presence of a sharp decline between 2001 and 2008: from +0.2 to -0.4. Between 1980 and 2000, the curve fluctuates around the zero line, i.e. there was no linear trend in the absolute difference. One could expect the negative trend is now transforming into a positive one.

The index for non-ferrous metals (102) shows an example of the absence of sustainable trends in the normalized difference. The curve is rather a comb with teeth of varying width. Although varying, the distance between consecutive troughs is several years at least. Therefore, one should not expect a quick recovery in the price for nonferrous metals.

The index for metal containers (103) provides an excellent example of linear trends in the normalized difference. There are two distinct periods between 1960 and 2008 with a turning point in 1987. A sudden drop in the difference in the end of 2008 may symbolize the start of transition to a new period with a negative trend. Then the price for metal containers will be increasing at an elevated rate, i.e. the index will get back its price setting power.

The index for titanium mill shapes (102505) has been demonstrating an increasing price setting power since 1971 with the normalized difference declining from 0.3 in 1975 to 0.1 in 2003. Then a dramatic fall to -1.2 was observed between the second quarter (Q2) of 2003 and the third quarter (Q3) of 2006. Thus, this fall was not related to the 2008 recession. However, the sharp return to the long-term behavior observed between 2006Q3 and 2008Q2 was only delayed by the recession, but not for long time. The price index for titanium should be back to the sustainable trend.

The normalized difference for coal (051) had a quasi-linear trend between 1980 and 2000. Between 2000 and 2008, the difference was almost constant (+0.2), i.e. the absolute difference had a linear trend. In 2008, a sharp drop started, i.e. coal price started to regain its price setting power relative to the PPI. The price index for electricity has not been diverging far from the PPI since 1980. The drop in 2008 is related to the decline in the PPI rather than to own dramatic rise. The price for electricity is an inherently seasonal one.

The normalized differences for gas fuels (053) and gasoline (0571) are similar in shape, but the latter is characterized by a narrower dynamic range – from +0.5 to -0.7, than that for gas fuels – from +0.7 to -1.5. Timing of major changes is slightly shifted with gasoline leading by

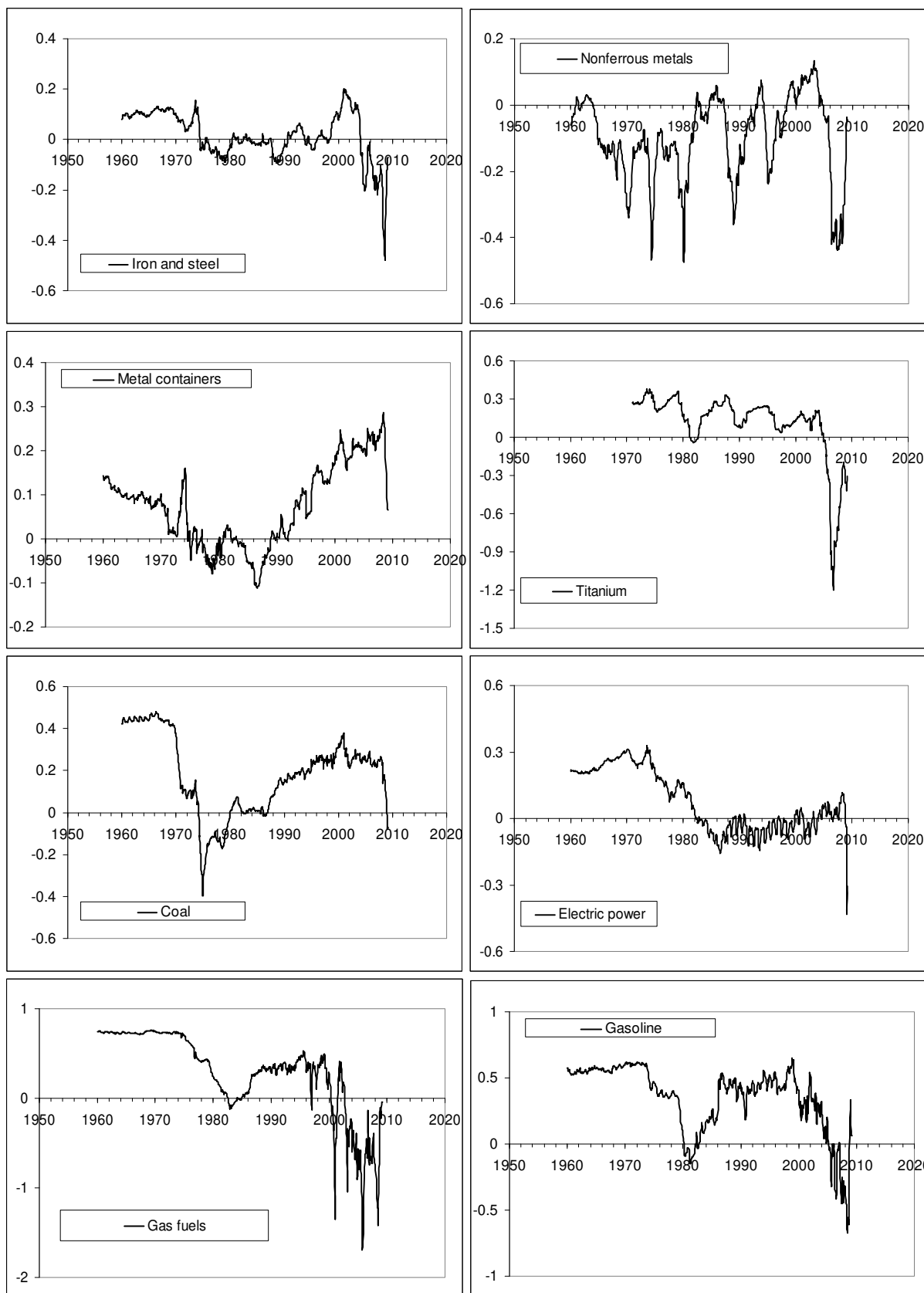


Figure 5. Differences between the PPI and price indices for second-level subcategories: iron and steel, nonferrous metals, metal containers, titanium, coal, electric power, gas fuels, and gasoline.

approximately one year. In general, the index for gas fuels suffered higher oscillations around the negative linear trend originated in the end of 1990s. The 2008 recession produced similar effects on both differences – a spike-like positive correction. In over words, both commodities lost a good portion of price. Such behavior completely repeats that observed for the index for energy and motor fuel [1,3].

### **Conclusion**

We have illustrated the presence of sustainable trends in the differences between the PPI and its components. As a rule, the differences demonstrate the presence of linear or nonlinear trends. Some subcategories reveal no trends. When exist, the trends can be approximated with a good accuracy by some simple functions of time. This allows predicting the future behavior of such indices relative to the PPI. In addition to practical usefulness, the sustainability of the trends must be rooted in the stability (or monotonic change) of economic conditions causing linear (or nonlinear) deviation from the PPI. Investigation of these conditions is an agenda for future research.

### **References**

1. Kitov, I., Kitov, O., (2008). Long-Term Linear Trends In Consumer Price Indices, Journal of Applied Economic Sciences, Spiru Haret University, Faculty of Financial Management and Accounting Craiova, vol. 3(2(4)\_Summ), pp. 101-112.
2. Kitov, I., (2009). Apples and oranges: relative growth rate of consumer price indices, MPRA Paper 13587, University Library of Munich, Germany, [mpra.ub.uni-muenchen.de/13587/01/MPRA\\_paper\\_13587.pdf](http://mpra.ub.uni-muenchen.de/13587/01/MPRA_paper_13587.pdf)
3. Kitov, I., Kitov, O., (2009). A fair price for motor fuel in the United States, MPRA Paper 15039, University Library of Munich, Germany, [mpra.ub.uni-muenchen.de/15039/01/MPRA\\_paper\\_15039.pdf](http://mpra.ub.uni-muenchen.de/15039/01/MPRA_paper_15039.pdf)